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Changes in the Cord and Nerves due
to Amputation, with Myelitis
and Neuritis.

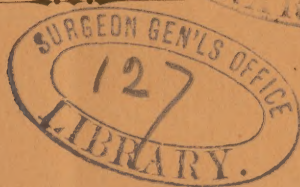
BY

S. G. WEBBER, M.D.,
BOSTON.

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Fig. 1.

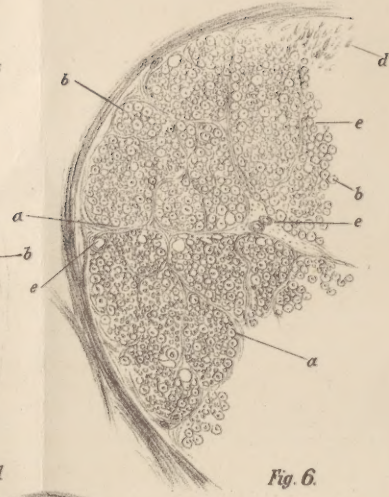


Fig. 6.

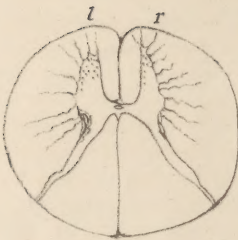
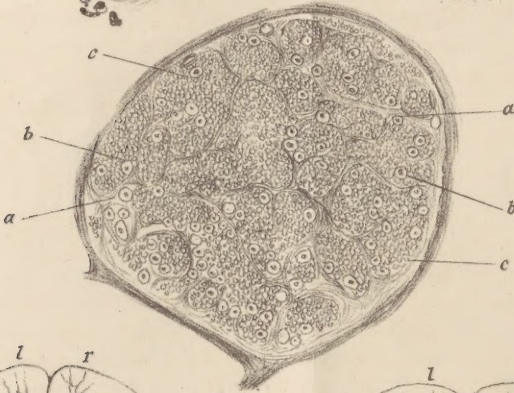


Fig. 8.
X 3

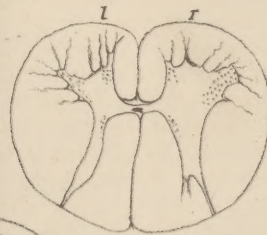
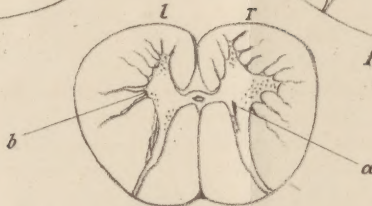


Fig. 9.
X 3



at 1st dorsal nerve

Fig 10. X 3

Webber Del.

Archives of Scient & Pract. Med. 1873.

C.C. Wright Lith.

V.

CHANGES IN THE CORD AND NERVES DUE TO AMPUTATION, WITH MYELITIS AND NEURITIS.

BY

S. G. WEBBER, M.D.,

BOSTON.

(WITH ONE LITHOGRAPHIC PLATE.)

THE following case contains several points of interest, and is, so far as I know, the only one of the kind recorded. I will first report the case, and then refer to the peculiarities which are most striking. I would say that the patient was treated at the City Hospital in this city, and the clinical record is copied from the books of that institution by the kind permission of Drs. Lyman and Blake who attended him.

J. F., aged 37, pedler, entered the hospital, Dec. 27, 1871. He lost his left arm in the battle of Fredericksburg about 9 years previously. During the winter of 1870-71 he had pain, said to be rheumatic, in the right knee, lasting a few days. He had no palpitation, no dyspnœa, no swelling of the feet. Two months before entering the hospital he began to feel weak, and had a slight cough; two weeks later he gave up work, and then first noticed swelling of the abdomen. He had epistaxis several times, and for a few days before entrance expectorated considerable thick bloody sputa. There was no pain in the chest, but it had been present in the right hypochondrium, extending across also to the left side. On entrance, the liver was considerably enlarged, its border being 3 or 4 inches below the costal cartilages, dulness beginning at the 5th intercostal space above. There was no tenderness over the liver on pressure, and its surface appeared smooth. The abdomen was somewhat distended; there was a slight pitting of feet and ankles; the skin was warm and dry, slightly jaundiced; pulse 96, resp. 16, temp. 99.5°; tongue brownish in centre, moist; appetite poor, thirst; bowels open daily, micturition free, urine high-colored; vomited occasionally.

The record merely mentions a continuance of the cough, epistaxis, and bloody sputa, with pain in legs and distress after eating, until it is said:—

Jan. 22, 1872. He is feeble, and unable to stand alone. There is very little cough, and bloody sputa only after epistaxis. His hand had been flexed, especially the ring and little fingers, for a few days; he was unable to open it—grasp not very strong. Examination of the lungs showed good resonance and vesicular respiration over the whole front; a souffle was heard with the first sound of the heart at the base, propagated into the carotids, heard very faintly also at apex. No en-

largement of spleen; liver about same size as mentioned above—no pain, no tenderness on pressure over it. Urine contained bile, only a trace of albumen, and occasionally (very rarely) a hyaline cast.

Jan. 31. A marked bulging of the intercostal spaces during cough.

He gradually lost power over the arm and legs, his voice was reduced to a whisper, a bed-sore formed over the sacrum, there was epistaxis occasionally, the abdomen became distended and tympanitic, the liver seemed to diminish in size, there was oedema of the feet and ankles, urine became strongly alkaline, without albumen.

March 12, 9 A.M. Died.

I made the autopsy the next day, 31 hours after death. There were about $3\frac{3}{4}$ quarts of deep reddish serum in the left pleural cavity, the left lung was adherent to the inner portion of the diaphragm, and at one spot to the posterior wall of the thorax by a narrow band. The costal, diaphragmatic and pulmonary pleural surfaces were roughened by a uniform layer of lymph with a honey-comb appearance; the lung was firmly compressed, and contained no air; at apex were several nodules of degeneration, and two similar nodules at the lower part of the upper lobe. The right lung was not adherent, tissue healthy. The pericardial sac contained about two ounces of serum. The heart was normal in size and consistency; the valves were normal. There were about 4 quarts of light-reddish serum in the peritoneal cavity. The liver was very large, yellow, containing little blood, very firm. The spleen was about one-half larger than usual, and in its upper part, toward the median line, was a hard nodule about 1 inch in diameter, of a light-yellow color on section, surrounded by a thin layer of tissue more congested than elsewhere; the outline was clearly defined. At the lower border, toward the outer edge, was a smaller nodule, about as large as a pea, of similar appearance. The kidneys were rather large, the capsule peeled off cleanly; certain parts were more strongly colored than others, and there was an appearance of fatty change. Bladder contained considerable urine, rather offensive, turbid.

On each side of the rectum, at the bottom of the pelvis, was a superficial slough about one inch in diameter, which was united across the rectum in front by a bridge of sloughing tissue about one-quarter inch wide. On each side, near the brim of the pelvis, were a number of small hæmorrhagic spots beneath the peritoneum, none more than one-eighth inch in diameter.

Brain and its membranes were in all respects healthy in its gross appearances; arteries unobstructed.

Scattered over the posterior portion of the spinal arachnoid, below the cervical enlargement, were numerous small calcareous plates, varying in size from minute points to one-eighth inch in diameter.

The dorsal portion of the cord seemed softened, and under the microscope there were granular corpuscles in the white substance, and some of the nerve-fibres seemed abnormally large. In the anterior cornua were no granular corpuscles, but the cells seemed nearly twice as large as those in the cervical enlargement.

The cervical and lumbar portions were of normal consistency.

The nerves of the brachial plexus on the right side, when treated with liquor potassæ, showed a granular appearance in spots, as represented in Fig. 1. Some of the fibres in each bundle seemed to be healthy: *b*, among these were scattered fibres or groups of fibres, much smaller than the others; *d*, the most of the bundle of fibres showed irregularly-grouped masses of granules; *c*, very dark compared with the rest of the section, which had been made translucent by potassa. In these places the nerve-fibres were comparatively few in number, and there was an increase of the fibrous tissue. Perhaps the sheath, *a*, was a little thicker than normal, though of that I could not be sure.

There was none of this appearance on the left side. The larger nerves ended in neuromata; some of the smaller ones disappeared in the fibrous tissue without any well-defined termination.

The pons, medulla, cord and nerves were hardened, and subsequently examined.

Throughout the whole length of the cord the inner wedge-shaped portions of the posterior columns were found to have received a more yellow color from the chromic acid; they also took a deeper color from the carmine, and under the microscope showed few or no normal nerve-fibres. When treated by liquor potassæ or sodæ they did not show increase of the fibrous septa, as in sclerosis.

In several sections at different heights examined for amyloid bodies, these were found on the circumference of the cord, also in the fibrous trabeculæ and around the vessels running into the cord, but most abundantly in the posterior columns and the posterior parts of the lateral columns. In many sections they could not be seen in the anterior columns.

The central canal was filled with cells and nuclei, and there was a multiplication of nuclei around the canal. This increase of nuclei around the canal was not excessive. In the medulla oblongata the central canal was open.

At the apex of the calamus scriptorius, where the fourth ventricle becomes narrowed and covered in to form the central canal, was a hæmorrhage. In the section where this was first seen there were two hæmorrhagic foci, symmetrically situated one on each side of the median furrow. Fig. 2, *a*. On the left a small portion of the sec

tion bordering on the furrow was broken away. This section seems to lie between Fig. 8 and Fig. 9 of Dr. Clarke's paper on the Intimate Structure of the Brain (*Philos. Trans.*, 1868, Part I.). I have lettered this and the next figure in conformity with his plates: *t*, nucleus of spinal accessory; *t'*, nucleus of hypoglossal; *x*, hypoglossal nerve; *r*, spinal accessory nerve; *w*, olivary body. In Fig. 5, I call the nucleus in which the hæmorrhage was found, the spinal accessory; this was nearly the uppermost limit of the hæmorrhage, and it is possible that the lower portion of the vagus nucleus was

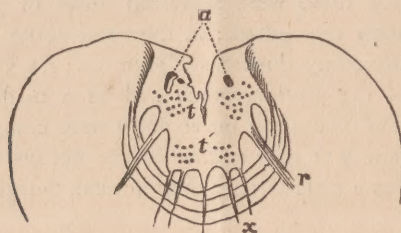


Fig. 2.

affected. The roots of the nerves were not long enough to determine the exact point of division between the two. Lower, the hæmorrhage was less marked on the right, more extensive on the left, and a small spot appeared in the centre just posterior to the central canal. Fig. 3,* the spot has disappeared from the right side. In this section the spinal accessory nucleus is unquestionably the one affected. Still lower, that on the left disappeared, and only the central spot posterior to the central canal remained, and soon this disappeared. The whole length of the hæmorrhage or hæmorrhages was not more than the tenth or eighth of an inch. The blood-corpuscles were quite clear, and showed distinctly, having preserved their shape. In front of the hæmorrhage were many of the nerve-cells of the nucleus still to be seen.

In these sections and throughout the medulla oblongata were numerous minute cavities; these were also found in the cord in the dorsal and lower cervical region. In the lumbar region and the upper cervical they were much less in number, and in many sections were entirely wanting. Fig. 4 † shows the distribution of these spots in the right half of the cord in the lower cervical region. Fig. 5 ‡ shows their distribution in the gray substance in the upper dorsal region. More highly magnified, they were seen to contain at first cholesterin or

* Fig. 3 not reproduced.

† Fig. 4 not reproduced.

‡ Fig. 5 not reproduced.

merely granular material (the specimen had been preserved in alcohol after hardening). After rendering the sections transparent with spirits of turpentine, only granular and illy-defined material could be seen in them. Whether ante-mortem or post-mortem I will not undertake to decide positively, but incline to think they are ante-mortem.

W. B. Kesteven figures a medulla oblongata with such cavities in the *Dub. Quart.*, 1869, but in his case no history is given.

Gray substance.—The proportion between the elements of the two halves of the cord varied somewhat at different heights. In the cervical region just above the enlargement, the right anterior cornua was more pointed and narrower than the left, and contained fewer nerve-cells, only about half as many; at the base both were nearly of the same size. Fig. 8. The posterior cornu were essentially alike. Lower, toward the upper part of the cervical enlargement, there was no difference between the gray matter of the two sides. Toward the lower cervical region, near the origin of the sixth or seventh cervical nerves, the gray substance on the left was smaller than that on the right. Fig. 9. Not only the anterior corner, but the central portion and the posterior cornu being diminished in size. At the point of origin of the upper fibres

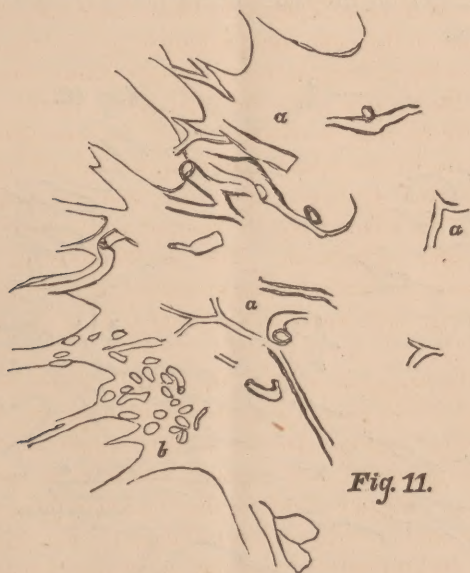


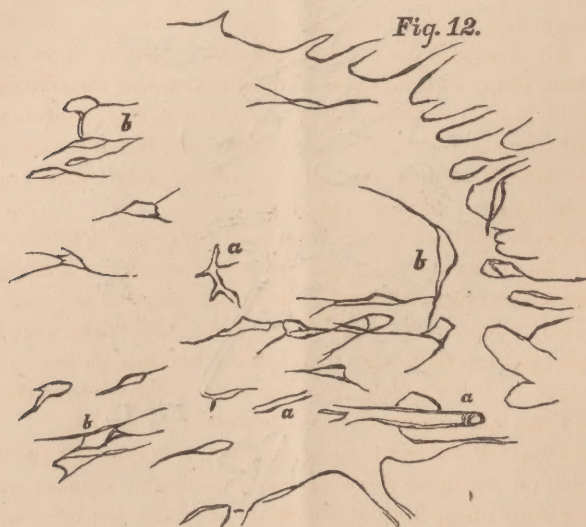
Fig. 11.

of the first dorsal nerve, the lowest of the brachial plexus, the difference between the gray matter of the two sides was greatest, the anterior cornu being most affected. Fig. 10. On the left there was, in half a

dozen sections from this neighborhood, either an entire absence of nerve-cells from the outer and posterior angle of the anterior cornu, or there were a number of small cells, diminished in size and crowded together at the posterior cornu, as at *b*, Fig. 10. Just anterior to these cells were many enlarged blood-vessels filled with blood-corpuscles. Fig. 11, *a*. The cells were small, without the usual prolongations. Fig. 11, *b*. There seemed also to be an increase of fibrous tissue and nuclei in this region compared with the right side. The corresponding region on the right contained a large number of nerve-cells with prolongations and very few blood-vessels: only one in this section of any size, though several capillaries could be seen which are not represented. Fig. 12. In the dorsal region there were slight differences between the two sides in the gray matter, in part at least depending upon local disturbances of nutrition, in part perhaps upon distortion by the knife, as this portion hardened much less evenly than either the upper or lower portion.

In the lumbar region there was no perceptible difference.

The *white substance* was only slightly affected. In the cervical region, even as high as the decussation, and in the upper dorsal, the left posterior column was smaller than the right. The antero-lateral column was larger on the side where the gray substance was the most atrophied.



At the level of the origin of the upper fibres of the first dorsal nerve was a hæmorrhage opposite the gray commissure. Fig. 10, *a*. The

anterior portion of the hæmorrhage was the widest, the posterior tapered off to a long and narrow process, running back to the right of the vesicular column of Lockhart Clarke. This hæmorrhage was seen on only a few sections, one immediately behind the other.

Lower, in the upper dorsal region, on a section cut longitudinally to study the nerve-fibres in such a section, was another hæmorrhage, situated in nearly the same part of the cord, opposite the gray commissure. In both these the blood-globules were well defined and had retained their normal shape. In the one at the level of the first dorsal nerve was a small cavity at its centre.

In the anterior and lateral columns there was a disproportionately small number of nerve-fibres ; some seemed to be larger than those in a healthy cord, many were smaller. In the posterior columns scarcely any fibres could be distinguished, at least the axis cylinders had disappeared, and only an irregular network of tissue remained.

In the cord and medulla oblongata the blood-vessels were not changed, except possibly that they were rather fuller of blood-corpuscles than usual, especially those of the pia mater ; their walls were thinner than usual rather than thicker. No crystals nor granules of the coloring matter of the blood were seen around the vessels.

The study of the nerves was very interesting. A thin section of a trunk of the brachial plexus on the left showed a decided decrease in the number of healthy fibres, very many being extremely small and appearing merely as small circles—in other words, atrophied. This was the only change, Fig. 6. On the right a section from the brachial plexus showed an increase of the thickness of the fibrous septa dividing the bundle of fibre, Fig. 7, *a* ; there was a greater amount of atrophy of nerve-fibres, Fig. 7, *c* ; again, the fibres which still retained somewhat of their normal characters were nearly one-half larger than those on the left, Fig. 7, *b*.

The anterior roots of the sixth cervical nerve on both sides were normal. The posterior roots on both sides behind the spinal ganglia contained a few atrophied fibres ; the posterior roots in front of the ganglia also contained atrophied fibres, rather more than were behind the ganglia and less than were found in the brachial plexus. A short distance, two to three inches, from the cord, the number of the small-sized fibres had increased, most, however, on the left.

In the lowest of the roots going to form the brachial plexus, the first dorsal, on the right, there were a considerable number of small fibres at a short distance from the ganglion. On the left this nerve was cut off so near the ganglion that no comparison could be made. Behind the ganglia the posterior roots on the two sides contained many small fibres ; the anterior were normal.

There was, however, this difference between the atrophied fibres in the brachial plexus in the arm and those in the roots, or within two or three inches of the cord. In the former place they were mere circles without axis cylinders, about $\frac{1}{3}$ or $\frac{1}{4}$ the diameter of the fibres which retained their size on the left, and about $\frac{1}{4}$ or $\frac{1}{8}$ the diameter of the enlarged fibres on the right. Near the cord the axis cylinder persisted, and could be seen in the centre of the small circles in most of the atrophied fibres, being absent from only a very few, if any.

In the spinal ganglia on both sides the fibrous septa and the sheaths of the nerve-fibres in many places contained collections of yellowish granules arranged in fusiform shape as if they filled cells, or in a few cases the groups of granules were round. Also many nerve-cells contained an undue proportion of such granules.

The middle and lower cervical sympathetic ganglia, the first and second thoracic on both sides, were carefully examined, and nothing abnormal was noticed, except perhaps that the cells of the left lower cervical ganglion were rather smaller by measurement than those of the corresponding ganglion on the right.

Changes in the cord due to previous amputation have been recorded in other cases, by Vulpian and Dickinson. In the present case, such changes differed in some respects from those found by them.

Vulpian has reported four cases in which changes were noticed in the cord, where death occurred several years after the amputation of a limb (see *Archiv. de phys. norm. et path.*, t. I. p. 443; t. II. p. 675). In these the white substance was diminished on the side of the lost limb, the gray substance was also somewhat affected. In one case (Vol. II. Case II.) the patient was 68 years old when the amputation was performed, and lived only 16 years after. In this case the changes were slight. In the other three cases the difference between the two sides was very marked. In two cases the posterior columns were diminished in size more than the anterior. In the other case the anterior column was chiefly affected.

In one case (Vol. I. Case II.) there had been atrophy of the muscles of the stump, and spots of degeneration were found in the anterior cornu of that side.

The posterior roots had not undergone any change in any of these cases. In all four the leg or thigh had been amputated.

Experiments were made by Vulpian on rabbits, the nerves of one hind-leg being divided and the cord examined several weeks after. His conclusions are: "Changes in the spinal cord are produced so much the more rapidly, and are so much the greater in extent, as the individual is younger at the time of the operation, and as a longer

time has elapsed between that and death. . . . The changes do not consist simply in an arrest of development. . . . It may be observed that the nervous fibres are atrophied."

Dr. Dickinson has examined the cord in three cases after amputation, and the sciatic nerve of the stump once without the cord. The changes in the nerves of the stump, as described, were almost the same as in the present case, excepting that he states that the "dwindled representatives of nerve-fibres (the small circles) were not, like the healthy tubes, in contact with each other, but were separated by and imbedded in a structureless material, which, from its power of imbibing carmine, was the means of imparting the peculiar pink tint to the section." This absorption of carmine, in the present case, seemed rather due to the tissue forming the circumference of the circles, and the general pink tint was owing to the large number and very minute size of these circles collected in one spot.

Dr. Dickinson sums up the changes found to consist of this atrophy, affecting the posterior roots rather than the anterior.

"Thirdly, a slight loss of bulk in the gray matter of the cord, on the side of the lost member, near the origin of its nerves, without any intimate change discernible by the microscope.

"Lastly, a remarkable shrinking of the posterior column of the cord on the side of the mutilation, attended by a condensation of areolar tissue. The atrophy extends upward, and in the case of the loss of an arm can be traced into the medulla oblongata as far as the upper limit of the decussation of the pyramids.

"The cerebrum and cerebellum remain unchanged."

The changes, which are probably a consequence of the amputation in the present case, are in some respects the same as those found by Vulpian and Dickinson.

The posterior column was diminished in size on the side of the lost limb; so it was in all the cases except one of Vulpian's, so it was in the rabbits on which he experimented; Dickinson found the same change. The inflammatory changes which had occurred in the present case prevented any conclusion in regard to the comparative amount of fibrous tissue on the two sides.

The gray matter at the origin of the lower roots of the brachial plexus was much more extensively affected than in either of the other cases; this change, however, was on the same side with the lost limb. The nerve-cells were deeply affected, which was not found to be the case by Vulpian nor Dickinson. This difference may, of course, be in consequence of the other lesions which were present.

The condition of the nerve-fibres in the nerves of the stump and their roots was similar to what was found in Dickinson's cases.

In this particular it must be remembered that in his cases a longer period had passed between the amputation and death—at least 23 years.

The differences between his report and mine are : in his the anterior roots were affected as well as the posterior, but to a less degree ; in two cases the atrophy had destroyed the axis cylinders in the roots as well as in the trunk ; in one case the axis cylinder persisted. In the present case the anterior roots were healthy, the atrophied fibres of the posterior roots and of the trunks near the cord retained their axis cylinders. These differences may be owing to the difference in the length of life after amputation. If so, it shows that the change begins at the periphery, and is gradual in its progress toward the centre. The much smaller number of atrophied fibres near the cord and in the roots point to the same conclusion, though there is the possibility of a doubt in this respect, as the nerves would naturally receive healthy fibres above the amputation, and any comparison can only be imperfect.

The changes in the nerves on the right, and the other changes in the cord, have no points of comparison with the other cases, excepting one case of Vulpian, in which degeneration of the muscles of the stump had occurred, and foci of degeneration were found in the anterior corner on that side only.

From the atrophy of a large part of the nerve-fibres and the enlargement of those that remained on the right, also from the appearance found in sections made soon after removal from the body, it is seen that there was an affection of the nerves on that side which corresponds closely with interstitial neuritis as described by Virchow (*Geschwülste*, II. 523.—*Arch. f. path. Anat. u. Phys.*, Bd. 53, 441). This neuritis was greater at a distance from the cord, and the anterior roots were not affected, or only to an insignificant degree. It seems reasonable, then, to consider it peripheral in its origin.

As already mentioned, it is probable that the atrophy of the nerve-fibres on the left began at the periphery, and was much less near the cord. But the gray matter of the cord was changed on the left—a marked atrophy with destruction of nerve-cells and multiplication of blood-vessels. Unfortunately, there is no record as to whether there had been pain in the stump, and hence an irritation to the nerves which may have produced the degeneration of the anterior cornu. It is perhaps a little singular that this should have been shown in the anterior cornu when the anterior roots were not affected. It was, however, the central portion of the anterior cornu which was most affected, including the tractus intermedio-lateralis of Clarke. As the muscles supplied from this portion were gone, and as there is reason

to suppose that this region is specially concerned in the nutrition of muscles (see *Journal of Psychology*, Vol. V. p. 242), and as the reflex functions of the cord are dependent upon the nerve-cells of the anterior cornu, it is perhaps not strange that the posterior portion of that cornu should show change of form. In Vulpian's case, where yellow degeneration of the muscles had occurred, this portion was degenerated.

Or it may be supposed that even without pain an irritation was conveyed from the neuromata through the anterior roots, or the posterior roots, to the gray matter. Similar instances of the communication of morbid influence from an irritated nerve to the cord, producing disease of the latter, may be found in Feinberg's experiments (*Ueber Reflex-lähmung. Berlin klin. Wochenschrift*, 1871, 41, etc.); also in some cases of tetanus.

The communication of the irritation to the right side is singular, if this can be considered as the origin of the neuritis. Herein, however, there is reasonable ground for doubt. It must be remembered that this man was a pedler, exposed therefore to changes of weather and hardships; also, he had only one arm, and perhaps used it overmuch. Clinically, too, the first weakness was noticed in his legs, and there was disease of the abdominal viscera. We may find in these conditions sufficient cause for the unusual changes found in the nervous system. In these respects the case is allied to acute ascending spinal paralysis. There was inflammatory degeneration of the upper dorsal portion of the cord, affecting chiefly the white substance, the posterior columns most. Above and below, the pyramidal columns of Goll were chiefly affected. In the extent of this change it differed from secondary degeneration, which is only ascending. There was no true sclerosis, *i.e.*, increase of fibrous tissue causing destruction of nerve-fibres. The other columns had undergone change, but not to the same extent as the posterior.

The hæmorrhages in the cord were multiple, and occurred not very long before death, as the softening around them and the changes in the effused blood were not far advanced. Were these hæmorrhages merely another exhibition of the hæmorrhagic tendency, as shown in the repeated epistaxis?

The atrophy of the left anterior cornu was most marked at the origin of the first dorsal nerve. It is not unreasonable, then, to suppose that the fibres going to the lower part of the arm and those going to the hand arise chiefly from this region of the cord; while those supplying the upper part of the arm arise from a higher level. This is confirmatory of other facts. Thus, in a case of dislocation of the

fifth or the sixth cervical vertebra, which I saw at the City Hospital, by the kindness of the attending surgeon, and which has been reported by Dr. Bolles,* I was able to define accurately the distribution of the nerves which still retained their power of conveying sensation. On one side of a line was no sensation, on the other it was retained. This mapping out of the zone of sensibility was done very accurately by Dr. Bolles, and it will be seen that most of the fore-arms and posterior part of the arms was anæsthetic. The lesion was such that the sixth cervical nerve was the lowest which could have remained intact. The innervation of the anæsthetic parts must then have come from the lower roots of the brachial plexus, the first dorsal, eighth, seventh and possibly sixth cervical. In the present case it is the gray matter of the portion of the cord from which these arise which is chiefly affected, and the lowest portion most deeply. It is reasonable, then, to conclude that the hand and fore-arm, the lower portion of the upper extremities, are innervated from the lower portion of the brachial plexus, excepting possibly a small part of the radial border of the fore-arm.

The flexion of the right hand and fingers is also of interest in connection with the neuritis of the right brachial plexus, and the fact that the lower roots of that plexus were more affected than the upper, pointing in the same direction as the facts mentioned above.

Physiologically, there is one lesion of interest. The voice during the last month of life was reduced to a whisper, and near the close of life the whispering was accompanied with forced expiration. The inflammatory affection of the dorsal region may in part explain this; but the presence of a hæmorrhage in the medulla oblongata at the origin of the upper fibres of the spinal accessory may also have been a cause of the loss of voice, being in so far confirmatory of Bernard's experiments upon the upper fibres of the spinal accessory, showing that these are concerned in phonation. Had the whole of the spinal accessory nucleus in this region been affected, much more disturbance would undoubtedly have been present; as it was, many cells still remained.

The superficial slough over the rectum, also the sub-peritoneal hæmorrhages, are other interesting phenomena. There were no signs of general peritonitis, and the slough was almost exactly opposite the bed-sore over the sacrum. That over the rectum might be considered an internal bed-sore, and is an additional proof of the nervous origin of bed-sores.

As already mentioned, the course of the paralytic symptoms allies

* Boston Med. and Surg. Journal, Nov. 21, 1872.

this case with those belonging to acute ascending paralysis. To enter upon a consideration of that affection would add too much to the length of this paper, and may more conveniently be deferred to another time in connection with a less complicated case.

EXPLANATION OF PLATE V.

- FIG. 1. Section of right brachial plexus treated with liquor potassæ before hardening. *a*, sheath of bundle of fibres; *b*, healthy nerve-fibres; *c*, irregular masses of granular matter; *d*, atrophied nerve-fibres.
- FIG. 6. Section from left brachial plexus after hardening. *a*, fibrous trabeculæ; *b*, nerve-fibres which have retained their size; *c*, atrophied nerve-fibres, reduced to mere circles without axis cylinders; *e*, blood-vessels.
- FIG. 7 (not numbered in plate). Section from right brachial plexus after hardening. Lettered like fig. 6. The trabeculæ are thicker, the nerve-fibres not atrophied are larger, there are more atrophied fibres than on the left. Figs. 6 and 7 are magnified equally.
- FIG. 8. Section from upper cervical region above enlargement. *r*, right anterior cornu; *l*, left anterior cornu.
- FIG. 9. Section from lower cervical region. *r*, right; *l*, left.
- FIG. 10. Section at origin of upper fibres of first dorsal nerve. *r*, right; *l*, left; *a*, hæmorrhage; *b*, group of atrophied and compressed nerve-cells.

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Books for review, and exchanges, should be addressed to Dr. C. E. BROWN-SEQUARD, No. 18 East 29th St., New York City. Communications intended for publication in the Journal must be addressed to Dr. E. C. SEGUIN, Sub Editor, No. 17 East 21st Street, New York City.

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Amaurosis and Deafness in Diseases of the Brain.

Rational Treatment of Poisoning by Organic Substances.

On the Various Kinds of Hemiplegia.

On Counter-Irritation: Its Importance and Rational Use.

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On Pneumonia and other Lung Affections in Diseases of the Brain.

On Reflex Paralysis and other Affections produced by a Reflex Influence.

Analogies and Differences between several Remedies (Belladonna, Digitalis, the Ergot of Rye, and the various Bromides).

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